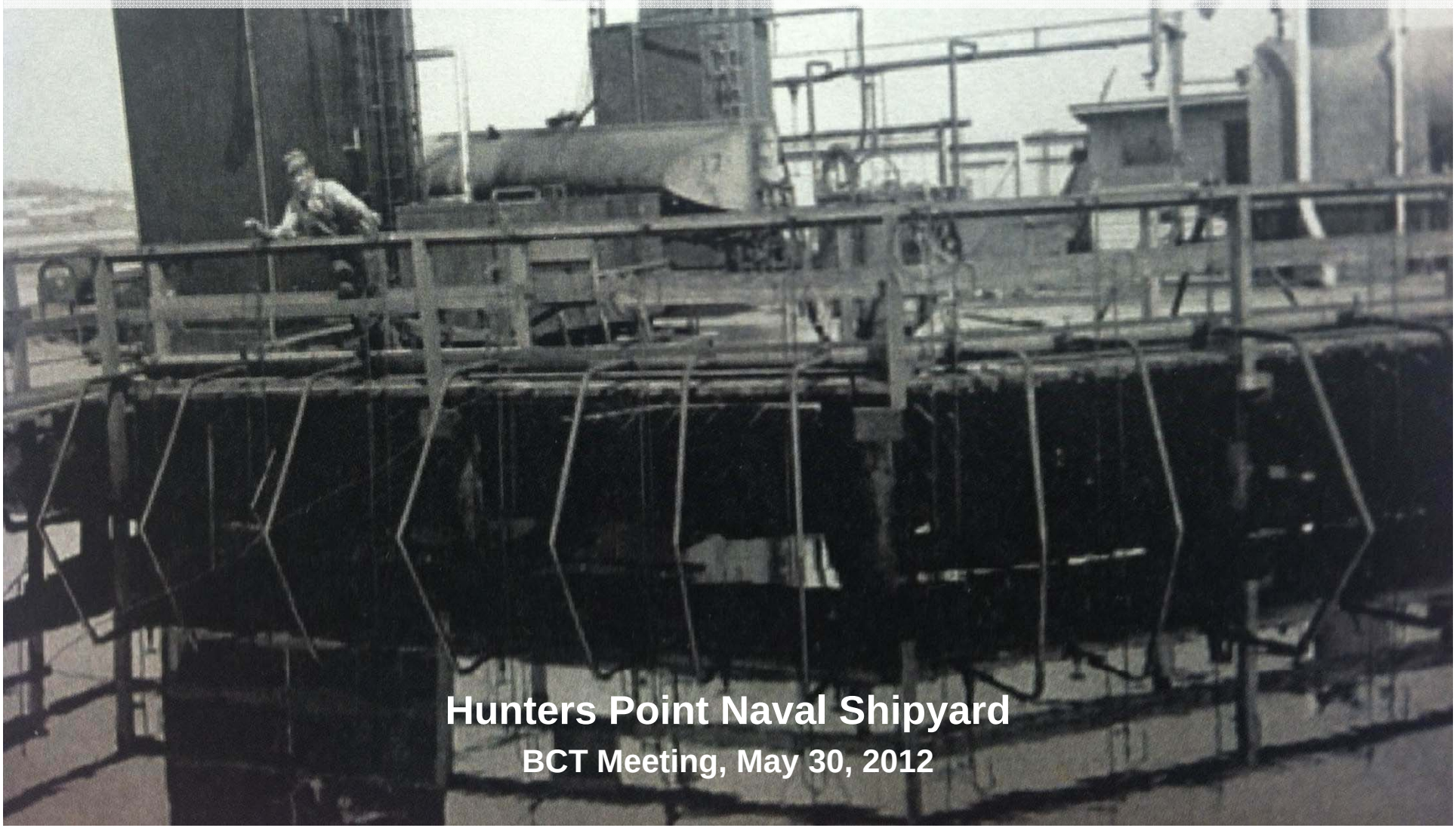
Parcel E IR-03 Non-aqueous Phase Liquid (NAPL) Characterization and Bench-scale Treatability Study Update



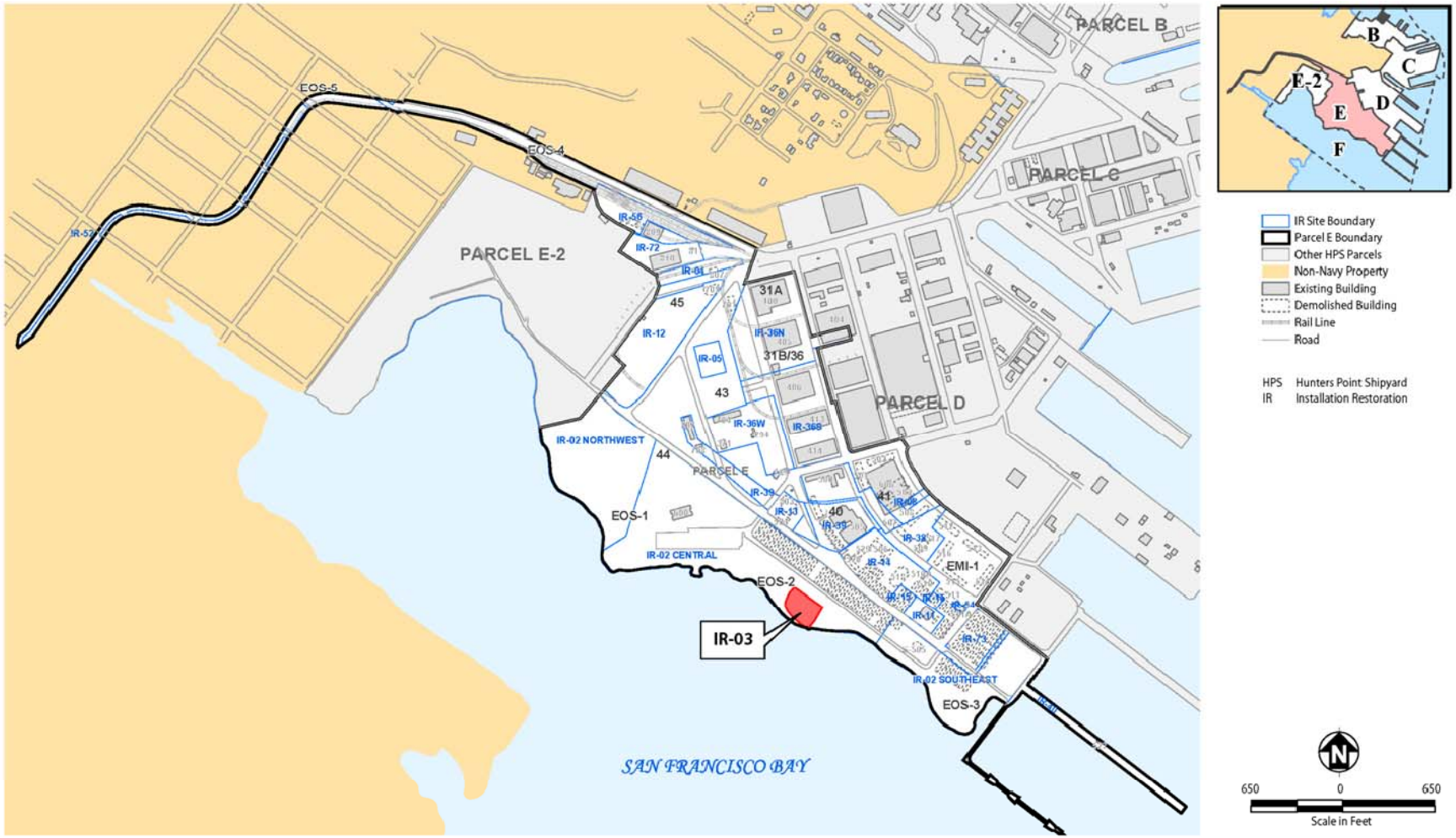
Hunters Point Naval Shipyard

BCT Meeting, May 30, 2012

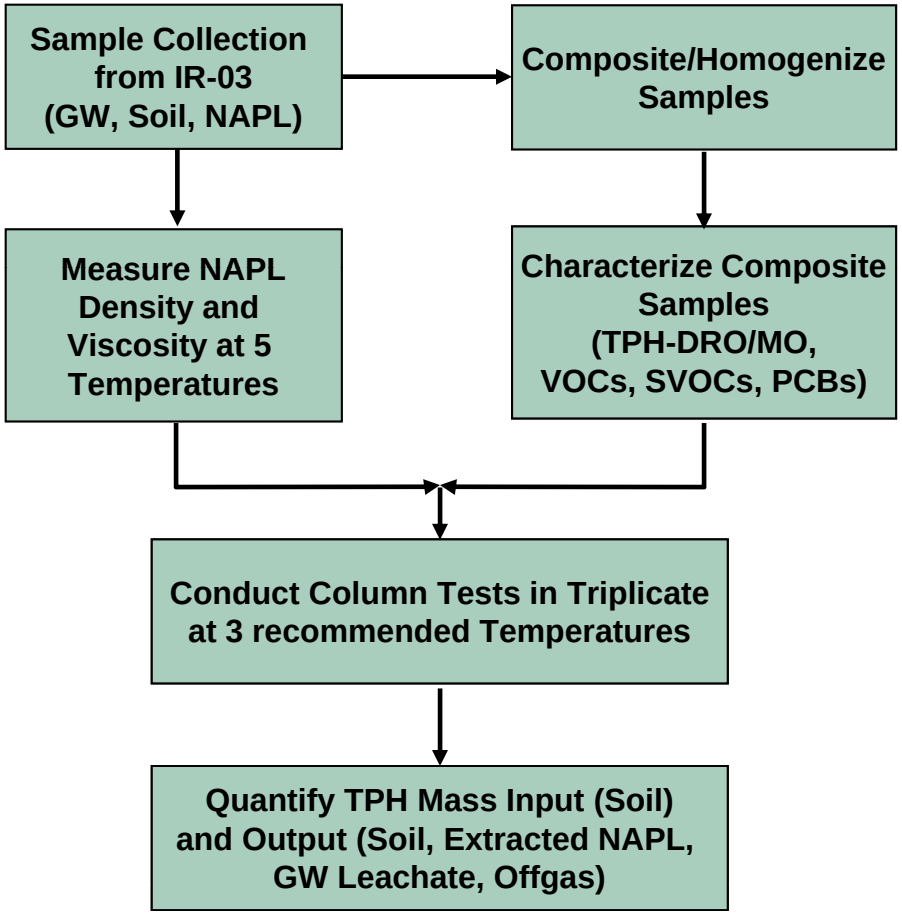
Presentation Overview

- **Bench-Scale Treatability Study (TS) Results**
  - TS Flow Diagram
  - Density and Viscosity Properties of NAPL as function of Temperature (30 to 90ºC)
  - Column Test Methodology
  - Column Test Results

Site Location



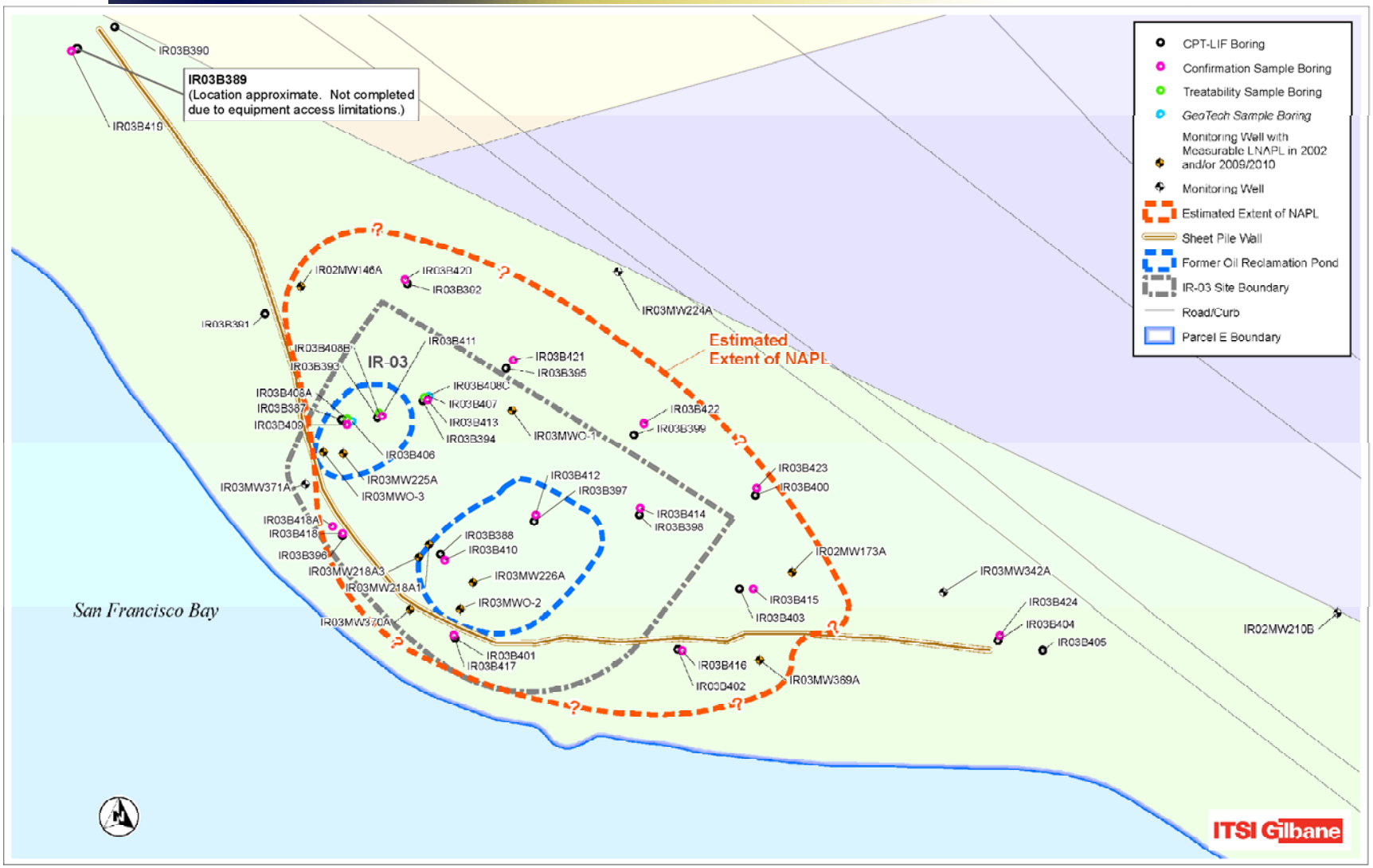
Treatability Study Flow



DRO-Diesel Range Organics

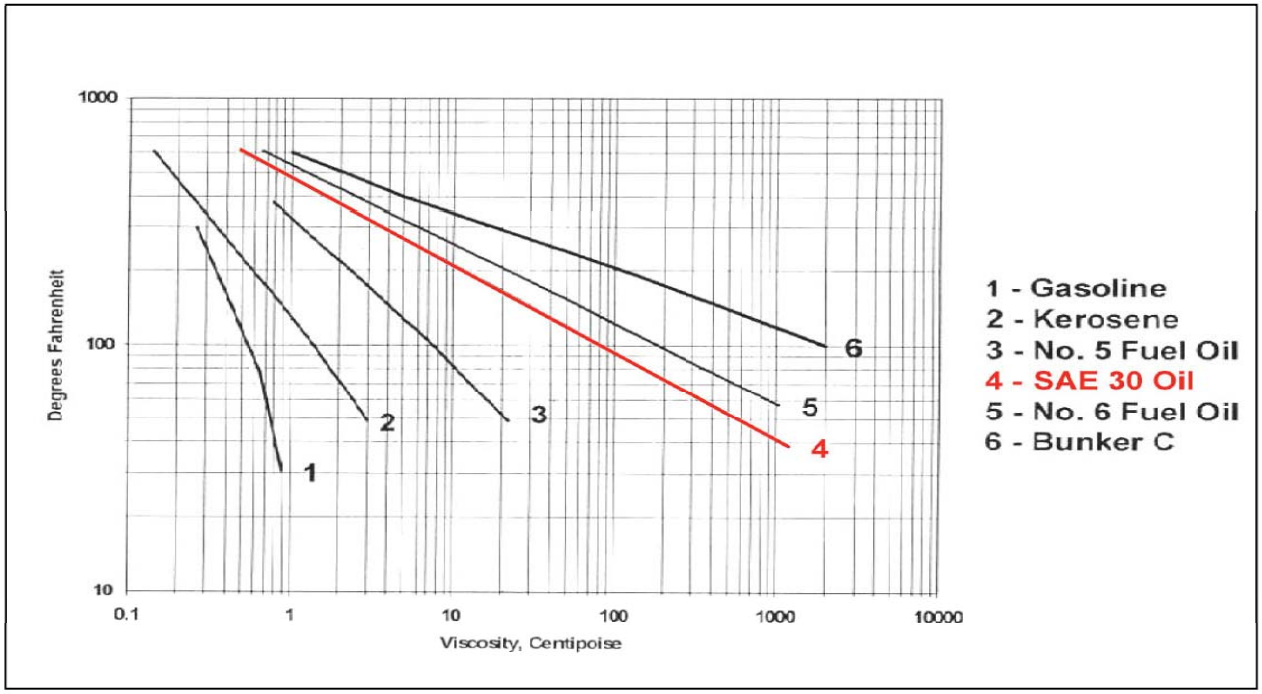
MO- Motor Oil

Lateral Extent of NAPL at IR-03



Bingham Pycnometer for Viscosity Determination

Viscosity of Hydrocarbons as Function of Temperature



(ref – J Dablow, "In-Situ Thermal Remediation for DNAPL Recovery", Proceedings Chicago Conference, 2001)

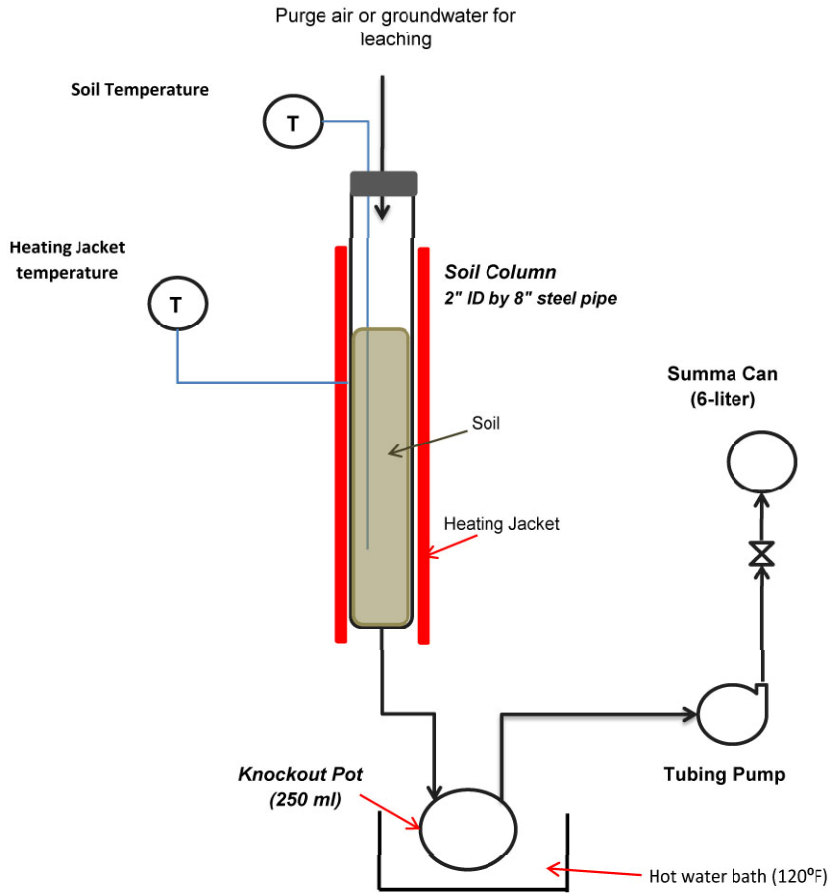
NAPL Density / Viscosity with Temperature

Temperature (°C)	Density (gm / mL)	Viscosity (centipoise)
17	0.944	Not Measured
30	0.931	134.2
45	0.922	64.75
60	0.912	34.3
75	0.902	21.5
90	0.892	13.3

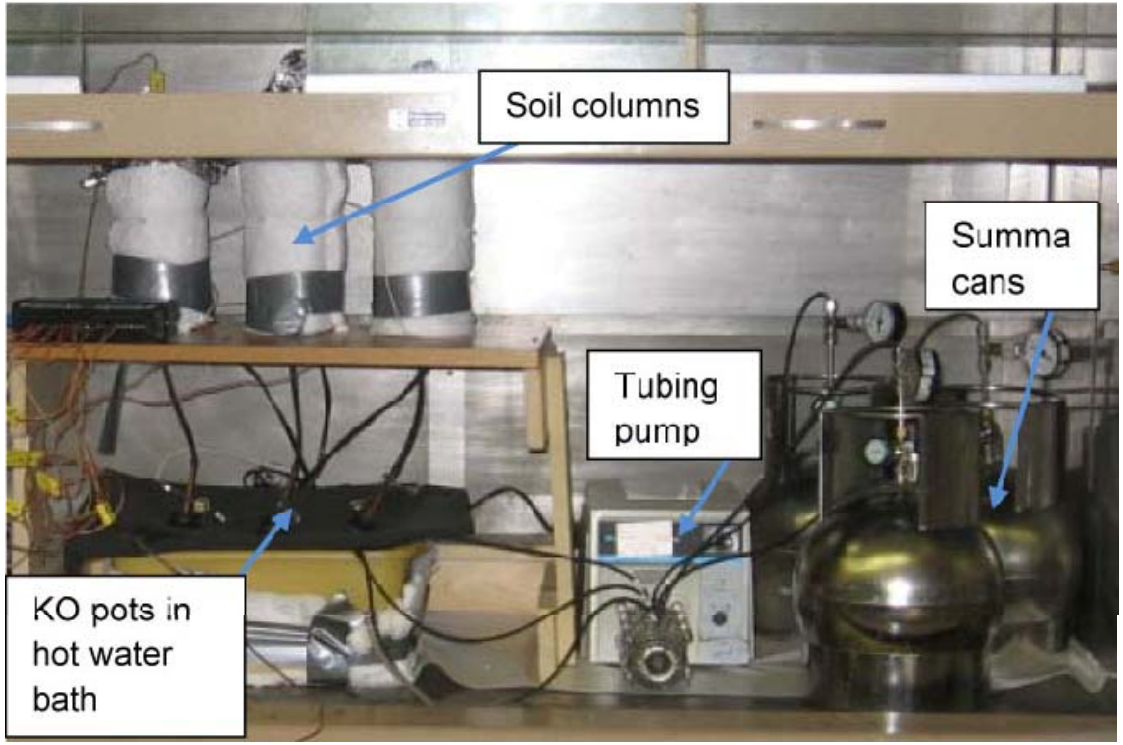
- Measured Viscosity of NAPL is similar to SAE 30 Motor Oil.
- Considering Ratio of DRO and MO in NAPL-impacted Soil, NAPL probably a Mix of Weathered Diesel Fuel, Motor Oil and heavier Gear Oils, and possibly Bunker Fuel Components.

*The viscosity of gasoline at 15°C is 0.5 centipoise

Treatability Study Column Study Schematic



Soil Column Apparatus



Column Study Details (conducted in triplicate)

Input

- 550± grams (gm) NAPL-Impacted Soil placed inside 2-inch diameter Steel Pipe at Density of 1.73 gm/cm^3
- Representative Soil Sample from NAPL-Impacted Soil Composite Weighed and Analyzed for TPH-DRO/MO to Quantify TPH Mass Input

Heating

- Electric Heating Jacket Wrapped Around Pipe with 2 Thermocouples (One in Middle of Soil and One between Jacket and Pipe)
- Soil Heated at Designated Temperature for 48 Hours
- 5 to 6.5 Liters of Air Purge during Heating w/ Off-gas Collected in Summa Canister

Post Heating

- Soil Flushed with 300 mL Heated GW over 24 Hours
- Collected Output Samples (Soil, GW, KO Wash, and Off-gas), Weighed, and Analyzed for TPH (DRO and MO) to Determine TPH Mass Outputs

Treatability Study Column Study Results 65°C

TPH Mass Input:							
	DRO	%Total DRO	MO	%Total MO	Vapor	%Total TPH	Total
mg	mg		mg		mg		mg
Total TPH Input	2,506	--	3,655	--	--	--	6,161
TPH Mass Output:							
Treated Soil	2,370	99.6	3,376	99.8	--	--	--
Condensate &IPA Rinse	0.07	0.003	0.17	0.01	--	--	--
Groundwater Flush	0.4	0.02	0.5	0.01	--	--	--
Leachate	6.5	0.3	7.9	0.2	--	--	--
Off-gas	--	--	--	--	0.6	0.01	--
TOTAL	2,378		3,384		0.6		5,762

Deviation (Output relative to Input): -6.5%

Treatability Study Column Study Results 90°C

TPH Mass Input:							
	DRO	%Total DRO	MO	%Total MO	Vapor	%Total TPH	Total
mg	mg		mg		mg		mg
Total TPH Input	2,204	--	2,924	--	--	--	5,128
TPH Mass Output:							
Treated Soil	2,702	99.41	3,790	99	--	--	--
Condensate &IPA Rinse	0.4	0.02	0.8	0.02	--	--	--
Groundwater Flush	0.4	0.02	0.5	0.01	--	--	--
Leachate	12.5	0.5	22.4	0.6	--	--	--
Off-gas	--	--	--	--	2.6	0.04	--
TOTAL	2,718		3,814		2.6		6,535

Deviation (Output relative to Input): 27.4%

Treatability Study Column Study Results 180 to 300°C

TPH Mass Input:							
	DRO	%Total DRO	MO	%Total MO	Vapor	%Total TPH	Total
mg	mg		mg		mg		mg
Total TPH Input	3,000	--	3,772	--	--	--	6,772
TPH Mass Output:							
Treated Soil	495	67	1,297	96	--	--	--
Condensate &IPA Rinse	234.6	31.8	28.9	2.1	--	--	--
Groundwater Flush	0.4	0.06	0.5	0.04	--	--	--
Leachate	8.5	1.2	27.7	2.04	--	--	--
Off-gas	--	--	--	--	74.8	3.45	--
TOTAL	738		1,354		74.8		2168

Deviation (Output relative to Input): - 68%

Treatability Study Column Test Results

- **Column Tests at 65ºC and 90ºC did not show TPH reduction**

- **Column Test at 180ºC to 300ºC showed substantial TPH reduction by both mobilization and destruction**

Schedule

- **Draft IR-03 Report …….. Aug. 2012**
- **Final IR-03 Report…….. Jan. 2013**